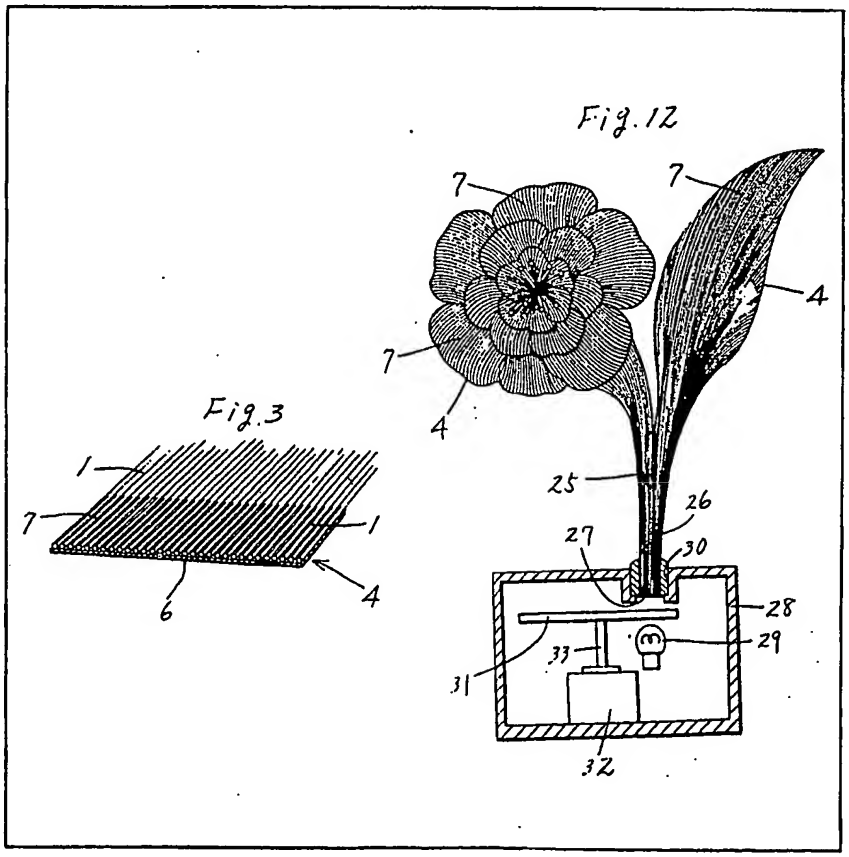
(12) UK Patent Application (19) GB (11) 2 028 561 A

(21) Application No 7924811
(22) Date of filing 17 Jul 1979
(23) Claims filed 17 Jul 1979
(30) Priority data
(31) 53/099817U
53/155378
54/046699
(32) 19 Jul 1978
8 Dec 1978
12 Apr 1979
(33) Japan (JP)
(43) Application published
5 Mar 1980
(51) INT CL³
G09F 19/12
(52) Domestic classification
G5C EP
(56) Documents cited
GB 1507725
GB 1489420
GB 1278691
GB 1250185
GB 1218107
GB 1217092
GB 847972
(58) Field of search
G2J
G5C
(71) Applicant
Tatsuo Murakami, 522 Kamiumamachi, Sanchome, Higashioji Higashiiru, Shibutanidori, Higashiyama-ku, Kyoto, Japan
(72) Inventor
Tatsuo Murakami
(74) Agents
Edward Evans & Co.

(54) Optical fibre illuminating device employing optical fibres

(57) This invention relates to an optical illumination device composed of optical fibre members. In the basic arrangement of a known optical illumination device one of the respective ends of the optical fibre members is opposed to a light source, with a filter disposed therebetween and movable across the path of incident light, the movement of the filter causing the other ends of the optical fibre members to illuminate with colors. The optical illumination device of the invention is characterized in that a number of optical fibre members 1 are arranged in a substantially planar form and fixed in position to form a sheet-like portion 4, one surface of which is suitably broken to provide a substantially planar light-leaking section 7.



GB 2 028 561 A

Fig.1

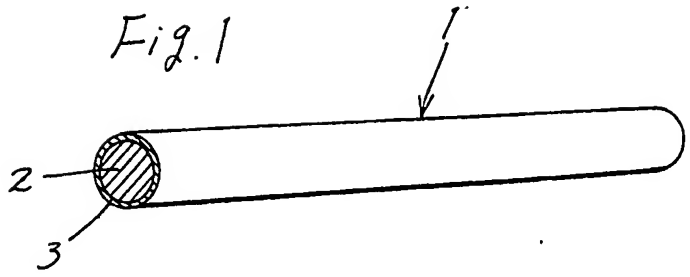


Fig.2

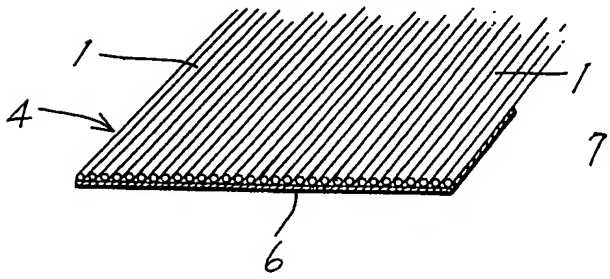


Fig.3

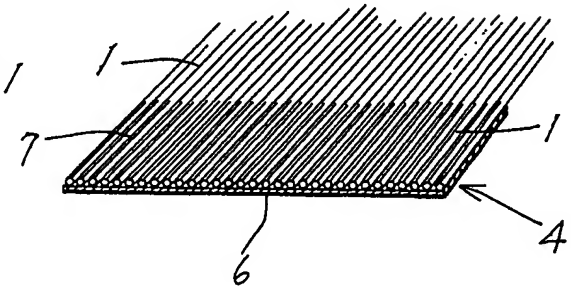


Fig.4

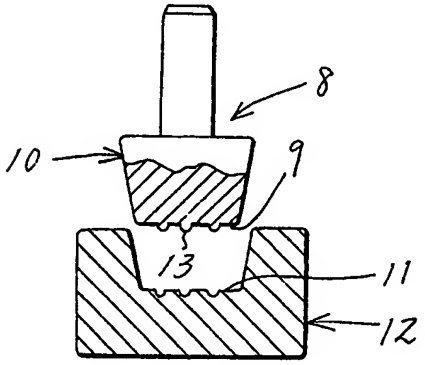


Fig.7

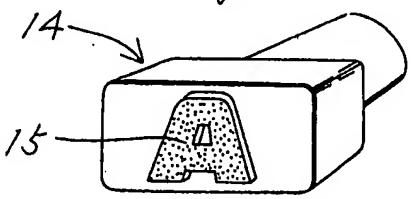


Fig.5

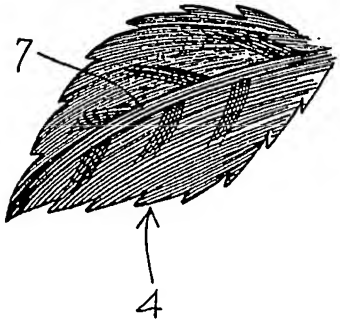


Fig.8

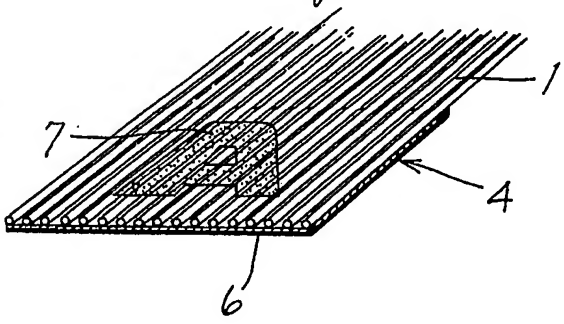


Fig. 6

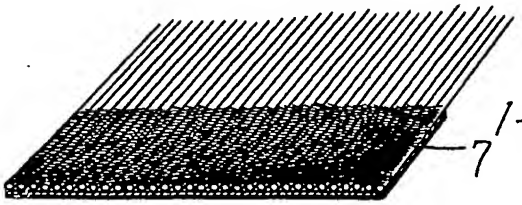


Fig. 9

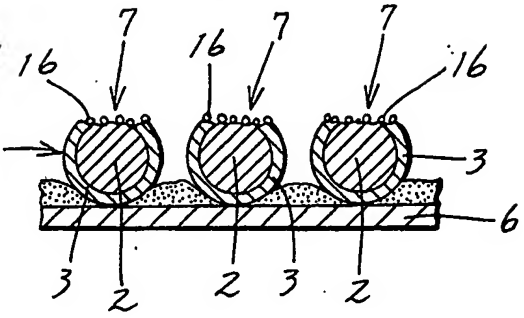


Fig. 13

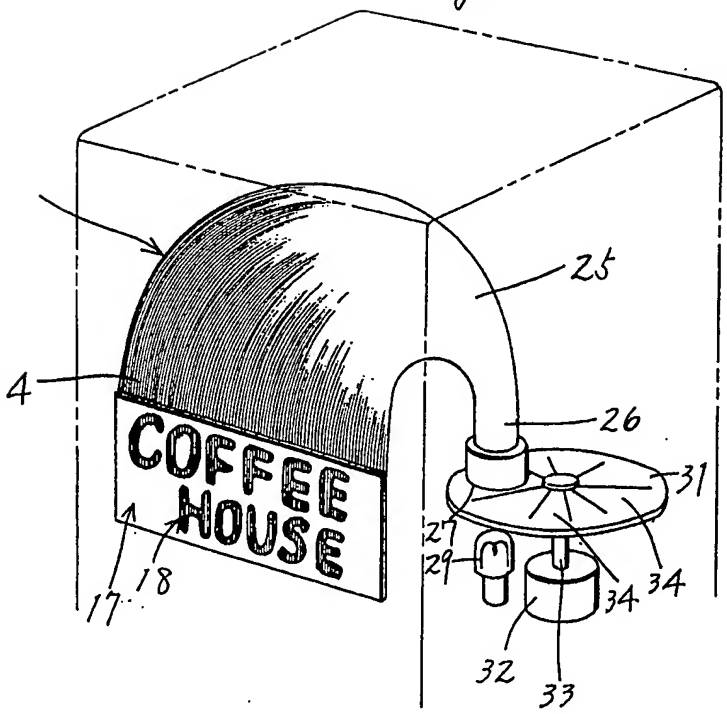


Fig. 14

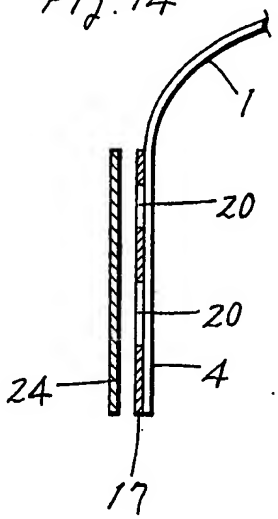


Fig. 10A

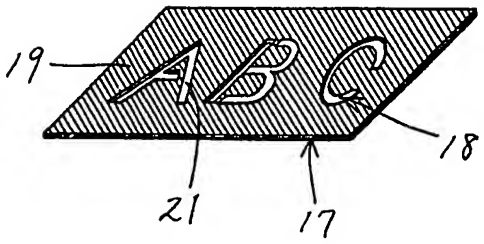


Fig. 10B

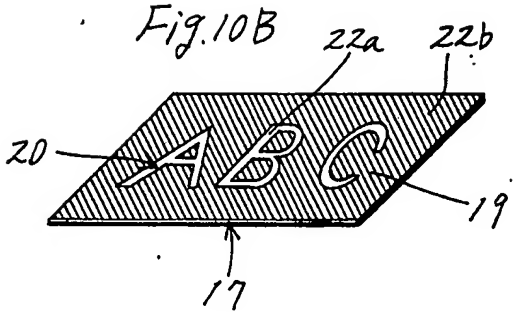


Fig. 11A

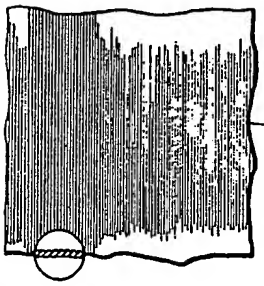


Fig. 11B

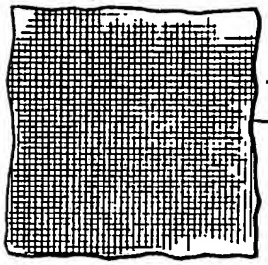
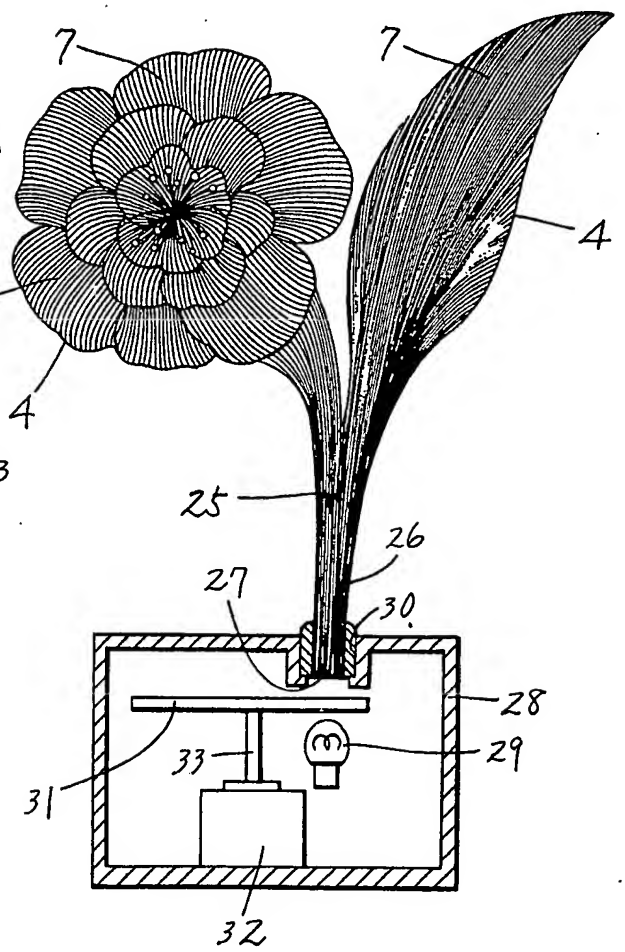


Fig. 11C

Fig. 12.



SPECIFICATION

Optical fibre illuminating device employing optical fibres

BACKGROUND OF THE INVENTION

The present invention relates to an optical illumination device employing optical fibres.

As is known in the art, an optical fibre is a slender bar-like optical light-transmitting element comprising a core and a sheathing layer concentric therewith which is made of a material having a lower refractive index than said core. Such optical fibre functions optically as a light-transmitting element to transmit light incident on one end thereof to the other end through the core while allowing the light to totally reflect on the interface between the core and the sheathing layer. In recent years, optical fibres of this type have been in great demand for use as light-transmitting elements for optical illumination devices including optical systems. Heretofore, optical illumination devices using such optical fibres have been arranged so that, in applying optical fibres, light incident on one of their respective ends is allowed to appear only at the other ends, such an arrangement lacking in variety and interest as an optical ornamental article.

OBJECTS OF THE INVENTION

An object of the present invention is to provide an optical illumination device using optical fibre members, wherein the illuminating portion of the optical fibre is arranged in a unique manner to achieve a variegated illumination effect on the ornamental area.

Another object of the invention is to provide an optical illumination device which is simple in construction and easy to produce.

SUMMARY OF THE INVENTION

According to one aspect of the invention there is provided an optical illumination device comprising a plurality of optical fibres connected together one adjacent the other into an array of fibres with the ends of the array being, constituted by the respective fibre ends, a light source disposed to illuminate one end of said array, and thus one end of each of the fibres, so that light passes through the fibres to the other end of the array, and thus the other end of each of the fibres, a filter disposed for rotable movement across the path of incident light from said source to said one end of the array, and wherein at least one end surface of said array is provided with a light-leaking area, whereby rotation of the filter causes said light-leaking area variably to illuminate with light of varying colours.

According to another aspect there is provided a method of forming an optical illumination device wherein a plurality of optical fibres are connected together one adjacent the other into an array of fibres with the ends of the array being constituted by the fibre ends so that light incident on one end of the array is transmitted by the fibres to the other end of the array, and wherein at least a portion of one surface of said array is processed to provide a light-leaking area for light being transmitted along said fibres.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings wherein:

Figure 1 is an enlarged perspective view of an optical fibre member applied to the present invention;

Figure 2 is a perspective view illustrating an example of a sheet-like portion of optical fibres arranged to be applied to the present inventive device;

Figure 3 is a perspective view illustrating an example in which external breaks are provided on one surface of such sheet-like portion;

Figure 4 is a sectional view illustrating an example of a combination of uneven-surfaced dies used to provide an embossment and fibre breaks by heating and pressing the sheet-like portion of optical fibres;

Figure 5 is a perspective view of a sheet-like portion formed by the dies shown in Figure 4;

Figure 6 is a perspective view of a sheet-like portion formed by a file type die;

Figure 7 is a perspective view illustrating an example of a hot stamp die;

Figure 8 is a perspective view of a sheet-like portion formed by the die shown in Figure 7;

Figure 9 is an enlarged sectional view of a sheet-like portion formed by a heat and pressure treatment;

Figures 10A and 10B are perspective views illustrating mask means applied to the invention;

Figures 11A, 11B and 11C are schematic views illustrating examples of screen means applied to the invention; Figure 11C being greatly enlarged;

Figure 12 is a perspective view illustrating a first example of an optical illumination device constructed of optical fibres according to the invention;

Figure 13 is a perspective view of a second example of an optical illumination device having mask means applied thereto; and

Figure 14 is a partially side view of a second example of an optical illumination device having mask means and screen means applied thereto.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

An optical fibre member 1 as shown in Figure 1, is composed of a slender bar-like fibre material having a core 2 and a sheathing layer 3 concentric therewith having a different refractive index. The refractive index of the core 2 of the optical fibre 1 is usually greater than that of the sheathing layer 3. The core 2 is made of polymethyl methacrylate or the like, while the sheathing layer 3 is made of fluorine-containing copolymer resin or the like.

The optical fibre members 1 are connected and fixed together by suitable connecting means to form a substantially planar sheet-like portion 4 of optical fibres. The optical fibre members are

parallelly connected and fixed together by suitable connecting means without any clearance or with a very small clearance between adjacent members. The connecting means for connecting and fixing said optical members in a substantially planar form may be a suitable adhesive agent by which the optical fibre members are simply bound together or a combination of a sheet member 6 serving as a base in the form of a thin fabric or silk, synthetic fibre or the like, a synthetic resin film, net or other light-penetrable sheet, and an adhesive agent. The operation of forming the sheet-like portion 4 of optical fibres is carried out by firstly attaching a connecting sheet member 6 of desired width to the outer peripheral surface of a cylinder along a generatrix line in advance and spirally winding a continuous optical fibre around the cylinder with a very small clearance between adjacent convolutions and suitably fixed to the connecting sheet member 6. Thereafter, the optical fibre wound around the cylinder is cut along a generatrix line in connection with the attaching position of the connecting sheet member 6.

The optical fibre members 1 thus formed are then processed to form the ornamental portion of the optical illumination device in the following manner.

The sheet-like portion 4 is shaped by cutting into a petal, leaf or any other significant form. Almost simultaneously with this cut-shaping treatment, a broken light-leaking section 7 capable of illumination is provided on one surface of the sheet-like portion 4 of optical fibres substantially over its entire area. The breaks allowing for the passage of light are formed by chipping the sheathing layer on the outer surface of the optical fibre. Further, the breaks may be made by physical means, for example, high frequency waves to fracture the internal fibre structure so that light may pass through the fractured portions.

The light-leaking breaks may also be formed by heating and pressing using a suitable die, for example a file type die (See Figure 6), or by a combination of uneven-surfaced dies 8 as shown in Figure 4. The dies 8 are a combination of a raised die 10 having a raised surface 9 and a recessed die 12 having a recessed surface 11, the surfaces 9 and 11 having a desired pattern, for example, a leaf form. The surface 9 of at least one die 10 is provided with ridges 13 corresponding to the veins of a leaf. Preferably, the surfaces of the ridges 13 may be provided with small serrations suitable for effectively forming breaks on the sheathing layer of the optical fibre.

The sheet-like portion 4 of optical fibres is placed between the pair of dies and subjected to heat and pressure to form embossments and vein-like breaks on its surface.

The leaf-shaping process described above is only one example of the application of the invention, and it is possible to form an embossment of a suitable significant form and breaks on the worked surface by heat and pressure, by providing dies of any desired form.

In another example, a die representing a pattern, such as a letter, figure or design, for example, a die 14, as shown in Figure 7, having a letter "A" surface 15 is prepared. If the sheet-like portion of optical fibres is heated and pressed by using the die 14, it is possible to form so-called stamp type breaks 7. In this case also, if small serrations are provided on the surface 15 of the die 14, breaks can be effectively produced.

Fragments of metal, plastic or other light-scattering material or fine particles 16 of light-scattering material may be bonded to the light-leaking area 7 provided on the sheet-like portion 4 of optical fibres. This process for bonding fragments or fine particles 16 is performed almost simultaneously with the process for forming breaks on the sheet-like portion 4.

For example at the time of forming breaks by the die, desired fragments or fine particles 16 are scattered on the sheet-like portion 4 so that they become bonded thereto at the same time as the latter is heated and pressed by the die. As another example, the fragments or fine particles 16 are applied by coating to the light-leaking area 7 and to the neighboring region. In any case, the fragments or fine particles 16 are bonded to the light-leaking area and to the neighboring region for the purpose of scattering the radiating light at the light-leaking area.

A masking means 17, see Figures 10A and 10B, is suitably designed for the purpose of partly shielding the light-leaking area 7 to provide an illuminating portion 18 of predetermined pattern. The mask means 17 is formed, for example, of a highly light-shielding mask sheet member 19. The mask sheet member 19 has a light-penetrable portion 20. The light-penetrable portion 20 of the mask sheet member 19 may be formed, for example, by a cutout opening 21.

The mask sheet member 19 with the light-penetrable portion 20 is formed of a development-treated gelatin film, and has its light-penetrable portion 22a and light-shielding portion 22b formed by photographic development treatment, the resulting pattern being accurate. It can be formed with extreme ease and is very suitable as a masking means to be used in this invention.

It is desirable that the back side of the light-shielding portion of the mask sheet member, i.e., the side abutting against the planar light-leaking area of the optical fibres, be formed with a mirror surface by coating it with a light-reflecting material. The other side of the mask means may be coated with a paint, pigment or other highly light-shielding material, with the exception of the portion serving as a significant form with respect to the planar light-leaking area 7 of the sheet-like portion of optical fibres. The light-leaking area 7 may be formed by externally breaking the significant-form illuminating portion of the mask means after the mask means 17 has been formed. In this invention, in applying the mask means 17, in order to provide lateral leakage of light more effectively it is preferable to subject the front end

surface of the illuminating portion of optical fibres to light-shielding treatment using a suitable light-shielding material 23.

In addition to the masking means 17, the screen member 24 for varying the rays of leaking light on the principle of physical optics may be applied to the illuminating portion 18 formed by the masking means. The screen member 24 may, for example, be a reticular screen 24A, a checker-like carved line screen 24B, a mesh screen 24C or a focussing glass screen (not shown). If these screen members are applied to this invention, they will scatter or refract the radiating light from the light-leaking portion, thus providing a peculiar and interesting illuminating effect.

A first embodiment of the invention as an optical illumination device will now be described with reference to Figure 12. According to this embodiment, almost simultaneously with the formation of the light-leaking areas 7, the sheet-like portions 4 are three-dimensionally shaped by cutting to a suitable desired form, for example, a petal or a leaf. An extended portion 25 is suitably bunched and fixed by suitable means to form a light-receiving end base 26.

The bunched front end 27 of the light-receiving end base 26 is attached to a top opening 30 in a casing 28 so that it is facing a light source 29 disposed in the casing. A multicolor rotary filter 31 is disposed between the bunched end surface 27 of the light-receiving end base 26 and the light source 29. The multicolor rotary filter 31 is movable across the path of incident light between the bunched end surface 27 of the light-receiving end base 26 and the light source 29 to cause the light-leaking areas 7 to illuminate with varying colors.

The multicolor rotary filter 31 is attached to a rotary drive source 32, such as a motor, through a rotary shaft 33. The rotary filter 31 has colored penetrable segments 34 of suitable angular extent, each of which may be a monochromatic segment or a segment having multicolored stripes inclined with respect to the radius of the disc-like rotary filter 31. Further, the colored penetrable segments of the rotary filter may each have a perfectly light-penetrable portion and a perfectly light-shielding portion. Thus, the multicolor rotary filter is not limited to the embodiment described above provided that the manner of illumination of the illuminating section of optical fibres is regularly or irregularly changed by the movement of the filter when the light from the light source is introduced to the bunched light-receiving ends of the optical fibre members. Further, the multicolor rotary filter may be a combination of at least two filters placed on each other. Such at least two filters are driven at different rotational speeds, with one or some of the filters being continuously rotated and the other or others intermittently rotated. The rotation of the at least two filters may be forward or reverse.

With the optical illumination device according to this first embodiment, the sheet-like portions of optical fibres can be readily shaped by bending along the axial direction of the optical fibres to provide a significant form which gives the viewer a soft impression. Further, in producing a larger significant form, since the optical fibre members are arranged with a suitable clearance between adjacent members, the base which supports them can be made so that its diameter is small for the arrangement of the significant form. For example, when a petal, leaf and the like are to be represented, the stalk for the petal, leaf and the like can be made small in diameter, so that it is possible to simulate the real thing more realistically. Since adjacent optical fibre members are not in contact with each other, it is possible to form a light-breaking area even along one side thereof, and illumination can be observed not only at the light-leaking area but also at the back thereof. In this way it is possible to provide a device in which both the front and back of the significant form can illuminate.

A second example of an optical illumination device embodying the present invention will now be described with reference to Figure 13.

According to this example, the mask means 17 is attached to the sheet-like portion 4 almost simultaneously with the formation of the light-leaking area. A screen member 24, see Figure 14, may also be attached in addition to the mask means 17.

An extended portion 25 on the side opposite to the side where the sheet-like portion 4 is formed is suitably bunched and is bonded by a suitable adhesive means to form a light-receiving end base 26. The light-receiving end 26 may be arranged substantially linearly depending upon the type of the mask means 17 and may be arranged so that the linear light-receiving end is radiated with varying colors during the movement of the filter. The other arrangement of the second embodiment is the same as in the first embodiment, with the corresponding parts indicated by the corresponding reference characters.

Thus, the optical illumination device according to the second embodiment is such that the planar light-leaking area of the sheet-like portion of optical fibre is provided with mask means of predetermined pattern and a desired screen member, wherein the selective application of the mask means and screen member will make it possible to achieve a design full of variety. This optical illumination device can be applied to various indicating boards in connection with display in show windows and the like, signboards, nameplates, marks, picture frames, etc. Further, this device is capable of representing many pieces of information by a single light source and the combined use of a multicolor filter causes the significant form to appeal to the eye as if it were moving.

CLAIMS

1. An optical illumination device comprising a plurality of optical fibres connected together one adjacent the other into an array of fibres with the ends of the array being constituted by the

respective fibre ends, a light source disposed to illuminate one end of said array, and thus one end of each of the fibres, so that light passes through the fibres to the other end of the array and thus the other end of each of the fibres, a filter disposed for rotable movement across the path of incident light from said source to said one end of the array, and wherein at least one surface of said array is provided with a light-leaking area, whereby rotation of the filter causes said light-leaking area variably to illuminate with light of varying colors.

2. An optical illumination device as claimed in Claim 1, wherein said array is of ornamental shape, such as a petal and leaf, thus constituting a flower.

3. An optical illumination device as claimed in Claim 1 or 2, wherein the optical fibres are parallelly connected together with no clearance between adjacent optical fibres.

4. An optical illumination device as claimed in Claim 1 or 2, wherein the optical fibres are parallelly connected together be connecting means so that a small clearance is left between adjacent fibres.

5. An optical illumination device as claimed in any preceding claim, wherein the optical fibres are connected together by an adhesive.

6. An optical illumination device as claimed in any one of Claims 1 to 4, wherein the optical fibres are connected together using a penetrable sheet member.

7. An optical illumination device as claimed in Claim 6, wherein said thin sheet member is a penetrable woven fabric of silk or synthetic fibre.

8. An optical illumination device as set forth in any preceding claim, wherein said light-leaking area is formed by externally breaking the optical fibres.

9. An optical illumination device as set forth in any one of Claims 1 to 7, wherein said light-leaking area is formed by internally breaking the optical fibres.

10. An optical illumination device as claimed in any one of Claims 1 to 7, wherein said array of optical fibres is partly broken on at least one surface thereof, by heat and pressure along a predetermined pattern, thereby providing a light-leaking area.

11. An optical illumination device as claimed in any preceding claim, wherein fragments or fine particles of glass, metal, plastic or other light-scattering material are applied by coating to said light-leaking area.

12. An optical illumination device as claimed in Claim 11, wherein said fragments or fine particles are scattered prior to formation of said light-leaking area and are fixed in position by being heated and pressed.

13. An optical illumination device as claimed in Claim 1 or 2, wherein said array of optical fibres is broken over its entire surface to form a light-leaking area and mask means having a light-penetrable portion of predetermined pattern is provided on said planar light-leaking area.

14. An optical illumination device as claimed in Claim 1 or 2, wherein said array is broken at least all over one surface to provide a substantially planar light-leaking area, mask means which has a light penetrable portion of the predetermined pattern being disposed in said planar light-leaking area.

15. An optical illumination as claimed in Claim 14, wherein a light-scattering screen member is disposed outside the mask means provided on said sheet-like portion.

16. An optical illumination device as claimed in Claim 15, wherein said screen member is a reticular screen.

17. An optical illumination device as claimed in Claim 15, wherein said screen member is a mesh screen.

18. An optical illumination device as claimed in Claim 14, wherein said screen member is a focusing glass screen.

19. A method of forming an optical illumination device wherein a plurality of opticle fibres are connected together one adjacent the other into an array of fibres with the ends of the array being constituted by the fibre ends so that light incident on one end of the array is transmitted by the fibres to the other end of the array, and wherein at least a portion of one surface of said array is processed to provide a light-leaking area for light being transmitted along said fibres.

20. A method as claimed in Claim 19, wherein said light-leaking area is formed by externally breaking the optical fibres.

21. A method as claimed in Claim 19, wherein said light-leaking area is formed by internally breaking the optical fibres.

22. A method as claimed in Claim 19, wherein said array of optical fibres is partly broken on at least one surface thereof, by heat and pressure along a predetermined pattern, thereby providing a light-leaking area.

23. A method as claimed in any one of Claims 19 to 22, wherein fragments or fine particles of glass, metal plastic or other light-scattering material are applied by coating said light-leaking area.

24. A method as claimed in Claim 23, wherein said fragments or fine particles are scattered prior to formation of said light-leaking area and are fixed in position by being heated and pressed.

25. A method as claimed in any of Claims 19 to 24 wherein said array is formed into an ornamental shape such as a petal or leaf, by die pressing.

26. A method of forming an optical illuminating device substantially as hereinbefore described with reference to the drawings.

27. An optical illumination device substantially as hereinbefore described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.